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# NEW OVERWRAPPED TRAYS FOR McINTOSH APPLES

Agricultural Research Service  
UNITED STATES DEPARTMENT OF AGRICULTURE

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## NEW OVERWRAPPED TRAYS FOR MCINTOSH APPLES

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### SUMMARY

McIntosh apples bruise easily and require more protection than most other varieties during marketing. Bruising of McIntosh apples packaged in new high-post trays overwrapped with shrink film was compared to that in 3-pound polyethylene bags and six-apple fruit trays overwrapped with shrink film. The high-post trays hold 9 to 12 apples.

Three test truck shipments of McIntosh apples were made from Shelby, Mich., to Cleveland, Ohio. When examined upon their arrival in Cleveland retail food stores, only 7 percent of the apples packaged in the high-post trays were bruised compared to 78 percent in the polyethylene bags and 40 percent in the six-apple fruit trays. None of the apples packaged in the high-post trays had damage or serious bruises, but serious bruising and damage bruising averaged 25.2 and 23.8 percent of the apples packaged in polyethylene bags and 3.3 and 10 percent of the apples packaged in the fruit trays.

The cost of packaging materials and direct labor per pound of apples was 1.6 cents for the polyethylene bag; 3 cents for the high-post trays; and 3.3 cents for the six-apple fruit tray.

### INTRODUCTION

Approximately 60 percent of the apples produced for the fresh market are prepackaged before reaching the retail store. 1/ Polyethylene bags and small, film-overwrapped fruit trays are the most widely used packages, often displayed side by side in retail stores.

Previous investigations have shown that polyethylene bags do not adequately protect McIntosh apples. Ceponis, and others, 2/ found an average of 37.4 percent of bag-packed apples had bruises affecting an area greater than 3/4 inch in

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1/ More Produce Prepackaged in 1964. U.S. Dept. Agr., Press Release 3221-64, September 23, 1964.

2/ Ceponis, M. J., Kaufman, J., and Ringel, S. M. Quality of Prepackaged McIntosh Apples in New York City Retail Stores. U.S. Dept. Agr., AMS-461, 12 pp., 1962.



diameter when the apples arrived at retail stores after 60-mile truck shipments. Shadburne 3/ found an average of 26.9 percent of bag-packed McIntosh apples arriving at Florida destinations after truck shipment from Maine and Massachusetts had serious bruises.

Film-overwrapped fruit trays protect apples better than polyethylene bags. Fountain 4/ found that overwrapped trays almost eliminated serious and damage bruising on Red Delicious and Winesap varieties of apples. But he also found that 7 to 14 percent of the apples had very small bruises after transcontinental rail shipments, and almost all the bruises were on the clearly visible upper parts of the apples.

This study was made to find out if the bruising of McIntosh apples could be reduced by packaging them in "high-post" molded pulp trays, instead of in 3-pound polyethylene bags and six-apple (1 1/2-pound) overwrapped fruit trays, and to measure the costs of packaging McIntosh apples in these three types of packages. This variety bruises easily and requires more protection than most other varieties during marketing.

## PACKAGES AND SHIPPING CONTAINERS

### High-Post Trays

Two sizes of the experimental high-post molded pulp trays were studied. One size contained nine 2 7/8-inch apples and the other contained twelve 2 5/8-inch apples. Each tray was packed with about 3 pounds of apples, stem end up, and completely overwrapped with clear, heat-shrinkable, biaxially oriented, cast polyvinyl chloride (PVC) film (fig. 1). The trays had 1 3/4-inch-high posts and 1-inch-deep pockets. The high-post tray for nine apples was square--9 3/16 by 9 3/16 inches. Each nine-apple tray required approximately 28 inches of 18-inch-wide film. The twelve-apple tray was 11 1/2 inches long and 8 1/4 inches wide. Each twelve-apple tray required approximately 27 inches of 18-inch-wide film. The packed trays went through a hot air chamber to shrink the film overwrap. 5/

Two regular slotted shipping containers were developed for the high-post trays. The containers were constructed of 200-pound-test fiberboard and had a capacity of 12 trays. The box developed for the nine-apple tray had inside dimensions of 19 inches in length and width and 9 inches in depth. The trays were packed four to a layer, three layers deep, with a double-faced fiberboard

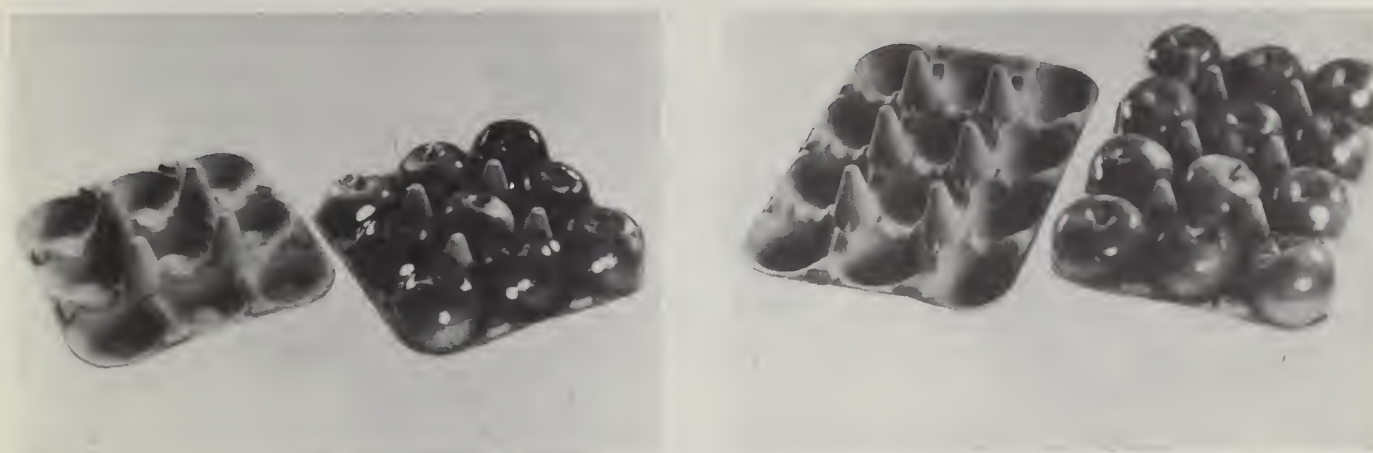
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3/ Shadburne, Ronald A. Loading Methods for Truck Shipment of Apples in Fiberboard Boxes. U.S. Dept. Agr., AMS-321, 27 pp., illus. 1959.

4/ Fountain, James B. Prepackaging Medium-Size Apples in Shrinkable Films at Shipping Point. U.S. Dept. Agr., Mktg. Res. Rpt. No. 534, 28 pp., illus. 1962.

5/ For detailed information on shrink film overwrapping of apple trays, see reference listed in footnote 4.

pad between each layer. The box used for the twelve-apple tray had inside dimensions of 25 by 11 1/2 inches and was 11 1/2 inches deep. The trays were packed three packages to a layer, four layers deep, with a double-faced fiberboard pad between each layer.



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Figure 1.--High-post trays. Left: nine-apple tray before packing (left) and after packing (right). Right: twelve-apple tray before packing (left) and after packing (right).

#### Fruit Tray

The molded pulp fruit tray was 8 1/4 inches long, 5 3/16 inches wide, with a flat bottom and sides 1 1/2 inches high. The trays were packed with six 2 1/2-to 2 3/4-inch apples weighing 1 1/2 pounds (fig. 2). Each package required approximately 19 inches of 18-inch-wide PVC film.

The shipping container used for the twelve-apple high-post trays also was used for the six-apple fruit trays. The fruit trays were packed, six packages to a layer, four layers deep, with a double-faced fiberboard pad between each layer.

#### Polyethylene Bag

The 3-pound polyethylene bags of 1 1/2-mil film included in this study measured 16 1/8 by 6 by 3 inches, and had 20 ventilation holes that were 1/4 inch in diameter. Each bag was packed with 13 to 16 apples (minimum diameter 2 1/4 inches) and was closed with pressure sensitive tape (fig. 2).

The regular slotted shipping container used for the polyethylene bags was constructed of 200-pound-test fiberboard and had a capacity of 12 bags. The box had inside dimensions of 29 1/8 by 12 5/8 by 12 5/8 inches. Each bag was packed in its own compartment, six bags to a layer, two layers deep. Compartments were formed with vertical and horizontal double-faced fiberboard partitions.





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Figure 2.--Conventional packages. Left: six-apple fruit tray. Right: three-pound polyethylene bag.

#### PROCEDURE

The three types of packages were packed in a Shelby, Mich., packinghouse that normally packs apples in polyethylene bags and fruit trays. All the apples were harvested from the same orchard. The bags were packed with the aid of semiautomatic weighing and filling machines. The fruit trays and high-post trays were manually filled and overwrapped with PVC shrink film. Approximately 400 high-post trays, 800 fruit trays, and 900 polyethylene bags were packaged during each of three test periods.

Three test truck shipments of apples were made from Shelby, Mich., to a central warehouse in Cleveland, Ohio. The packaged apples were then distributed to four retail stores.

The total elapsed time from shipping point to retail stores was approximately 40 hours. The stores varied in size and the number of boxes of apples delivered to each store varied but averaged 26 boxes, 13 boxes of trays and 13 boxes of bags per week. Twenty-five percent of the apples delivered to each store in each type of package was examined for bruising.

Direct packing labor costs were obtained during three packing periods by conducting time studies of specific operations. To avoid disclosure of confidential information, the time study data for the polyethylene bag and six-apple fruit tray were combined with similar data obtained from one other plant.



Packaging material costs were obtained from apple packinghouse managers and from manufacturers and distributors of packaging materials.

## BRUISING

Bruising was less for the apples marketed in the high-post trays than for those marketed in the polyethylene bags of fruit trays (table 1). Seventy-eight percent of the apples in the bags were bruised. Forty percent of those packed in the fruit trays and only seven percent of those packed in the high-post trays were bruised. The bags also contained more apples that were seriously bruised: 25.2 percent compared with 3.3 percent in the fruit trays and none in the high-post trays. Damage bruises--injury between 1/2 and 1 inch in diameter and less than 1/8 inch deep--also were more prevalent in the bags: 23.8 percent compared with 10 percent in the fruit trays and none in the high-post trays. All the differences were statistically significant at the 1-percent level.

The high-post trays protected the apples because the posts supported overhead weight and separated laterally the apples from each other. In the fruit trays, the apples were not separated laterally, and the apples, rather than the package, supported the overhead weight. The tight film overwrap immobilized the apples in both types of trays. The apples were not immobilized in the bags and the jostling of one apple against another caused more apple bruising in the bags than in the trays.

Table 1.--Percentage of McIntosh apples bruised and degree of bruising by type of package, in three test truck shipments, Shelby, Mich., to Cleveland, Ohio, 1964 1/

Type of package	Slight	Damage	Serious	Total
	Percent	Percent	Percent	Percent
High-post trays:				
9-apple tray .....	5.5	0	0	5.5
12-apple tray .....	8.3	0	0	8.3
Average .....	6.9	0	0	6.9
6-apple fruit tray .....	26.6	10.0	3.3	39.9
3-pound polyethylene bag .....	28.7	23.8	25.2	77.7

1/ Inspected upon arrival at retail stores after distribution through central warehouse. Degrees of bruising are--Slight: Bruising injury between 1/4 and 1/2 inch in diameter and less than 1/8 inch in depth. Damage: Bruising injury between 1/2 and 1 inch in diameter and less than 1/8 inch in depth. Serious: Bruising injury over 1 inch in diameter or more than 1/8 inch in depth. These degrees of bruising are not comparable to the terms "slight bruising," "damage by bruising" and "serious damage by bruising" used by Federal and Federal-State inspectors.

## PACKAGING COSTS

The cost of packaging materials and direct labor required to pack the three types of consumer packages per pound of apples was 1.6 cents for the polyethylene bag, 3.3 cents for the 6-apple fruit tray, and 3 cents for the 9- and 12-apple high-post trays (table 2).

Table 2.--Cost of packaging materials and direct labor to pack McIntosh apples per 36-pound shipping container, by type of package, Michigan, 1964

Item	: Experimental high- : post trays : (average 9- and : 12-apple trays)	: Fruit : tray	: Polyethylene : bag
	: <u>Cents</u>	: <u>Cents</u>	: <u>Cents</u>
Packaging materials:			
Shipping container (including staples, pads, and divider) ...	36.1	35.2	32.8
Bags (printed 2 colors) .....	----	----	11.7
Trays .....	22.6	19.5	----
Film .....	18.1	26.4	----
Labels .....	<u>4.2</u>	<u>8.4</u>	----
Subtotal .....	81.0	89.5	44.5
Direct packing labor <u>1/</u> .....	<u>26.1</u>	<u>30.4</u>	<u>12.3</u>
Total .....	107.1	119.9	56.8
Cost per pound of apples	3.0	3.3	1.6

1/ Includes labor to assemble shipping containers, position, fill and wrap trays or position, fill, and close bags, and pack shipping container, plus 15 percent allowance for personal time and fatigue. Labor operations not affected by type of package, such as supplying and sorting fruit, are not included.